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REFERENCE. PAMPHLET.

ICE-MANUFACTURE

—BY THE—

PROCESSES AND APPARATUS

—OF—

The De La Vergne Refrigerating Machine Co.

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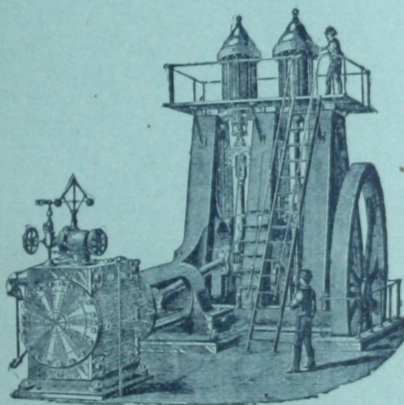

MANUFACTURERS OF

REFRIGERATING AND ICE MACHINES,

AND OF

ANHYDROUS AMMONIA.

OFFICE AND WORKS:

Foot of East 138th Street (Port Morris).

NEW YORK:

JOHN C. DE LA VERGNE, President;
LOUIS E. DE LA VERGNE, Vice-President;
CHAS. H. CONE, Secretary.

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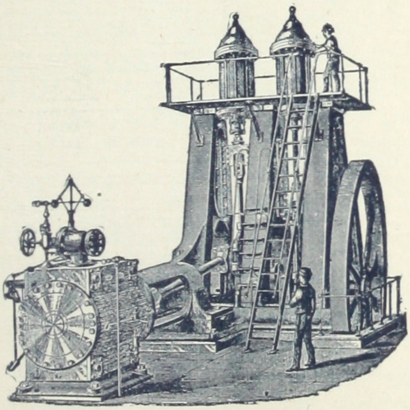

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PLATE 1.—Office and Works of the De La Vergne Refrigerating Machine Co.

New York, April, 1892.

TO THE USERS OF ICE-MACHINES.

THE rapid progress which the manufacture of ice in the United States has made during the last three or four years, partly on account of the repeated failure of the ice-crops, partly on account of the demand for purer and better ice than nature affords, makes it of interest to those who contemplate the erection of an ice-factory to know a little more of the different modes by which ice is to-day artificially produced. Not only is ice to-day made in the Southern States, in cities and small towns, but the large Northern cities are rapidly coming into line, boldly attempting competition with the natural-ice companies; and there seems no doubt that within a few years all our large Northern business centres will have their ice-factories. The economy of making ice is to-day so well established that it only requires the proper commercial enterprise and the necessary capital to make an undertaking of this kind successful.

FIRST ATTEMPTS AT ARTIFICIAL-COLD PRODUCTION.

As far back as the year 1550 Blasius Villafranca, a Roman physician, produced an artificial reduction of temperature by dissolving saltpetre in water, and in 1607 the first "frigorific mixture" was discovered by Latinus Tancredus, who, by combining snow with saltpetre, produced very low temperatures. A well-known frigoric mixture is used the world over to-day in the manufacture of ice-cream, viz., pounded ice and common salt, which produces a temperature of 10 degrees Fahrenheit. Other mixtures were, later on, discovered, some of them using ice or snow as an auxiliary, others using merely a combination of chemicals, such as sulphuric acid, muriatic acid, chloride of sodium, chloride of calcium. nitrate of ammonia, etc.

In 1824 Vallance patented an ice-machine, in which a current of dry, rarefied air was circulated over shallow pans containing water. The air absorbed the vapors of the water, and the heat necessary to produce these vapors was taken from the main body of the water and froze it. The air thus laden with moisture was passed over concentrated sulphuric acid, which absorbed the watery vapors and made the air fit again for taking up new vapors from the water to be frozen. Thus a continuous process was established.

In 1834 Perkins constructed a machine in which cold was produced by the evaporation of ether. The ether was vaporized in a cylindrical vessel containing tubes by reducing the pressure on it through the sucking action of a pump, which on its return stroke compressed the ether into another vessel cooled by water, thus restoring the ether and making it fit to be used over again. Here the compression system makes its first appearance.

FIRST PRACTICAL RESULTS.

IT is almost forty years since ice was made in the United States on considerably more than an experimental scale. In 1850 Professor Twining, of New Haven, Connecticut, obtained his first patent in England on an ice-machine, in which ether was used as the refrigerating agent. The American patent was issued to him in 1853, and in 1855 he operated a machine in Cleveland, Ohio, which was intended to produce 2,000 pounds of ice in twenty-four hours. It did actually produce over 1,600 pounds under disadvantages, and was operated, off and on, from 1855 to 1857.

LATER SUCCESSES.

AFTER Twining's first attempts very little progress was made for many years. European machines, especially Carré's absorption machine, were introduced into New Orleans about ten years later, and it was twenty years after Twining when the ammonia compression machines of the present day were introduced into our industries for the purposes of ice-making, as well as for the refrigeration of breweries.

To the great success of the brewing industry in the United States is due the rapid introduction of the ammonia compression machines for purposes of air cooling. Here was a field which offered great temptations for improvements, and the result was the perfection of the gas compressor, with all its other appurtenances, for the economical and reliable handling of the gas. This part of the apparatus having once obtained a high degree of utility, and having found a regular market in establishments requiring cold rooms, the next step forward was the application of the ammonia compressor to the purpose of ice-making.

During the last three decades almost innumerable patents have been taken out, all of which had in view improvements in the mode of freezing water for the market. One great drawback to making clear, transparent ice was, right in the beginning, found to be the air, which all water of nature contains in solution. As soon as such water begins to freeze, it eliminates the air in the shape of minute bubbles. If the process of freezing is rapid these small bubbles are trapped in the ice forming, thus rendering the latter opaque. While thereby the purity of the ice is not impaired, still its appearance makes it unsalable, and it melts considerably faster than the transparent article. If the freezing takes place at temperatures above 24 degrees the ice is perfectly clear on the outside, but the centre of a block thus frozen contains a large porous core, in which nearly all the air of the water which it held before freezing accumulates.

Many attempts at improvements in the freezing process of water have had for their object the making of transparent ice; others have aimed at shortening the time of freezing; but, on the whole, it may be asserted that the progress made cannot be compared to that which has attended the improvements in the gas-compressing and evaporating process; and much may yet be accomplished in that line.

THE GAS COMPRESSOR.

It is not our intention in this pamphlet to describe the different kinds of *machines* used for ice-making. Any one interested in this will find a treatise on this subject in our large illustrated catalogue. The machine system proper can in all cases be ap-

plied to refrigeration as well as to ice-making, and a description of a machine for the former purpose will also hold good for the latter. The absorption machine can be used for ice-making, and so can the compression machine, and any criticism relating to this part of the apparatus which handles the gas will apply to the same, for whatever object it is used. But our machine belonging to the class of ammonia compression machines, it would seem proper to describe in as few words as possible its arrangement and advantages.

The principal part of all compression machines which use a volatile liquid is the compressor. This is a gas-pump operated by a steam-engine, and draws the gas from the evaporating coils after it has there done its work of cooling, compresses it on the return stroke of the piston, and discharges it into a system of pipe coils called the condenser, in which, under the cooling action of water, it is transformed into a liquid. In the liquid state it is passed through a very small opening of the expansion-cock into the evaporating-coils, where it is again changed into the gaseous state on account of the diminished pressure prevailing in them through the sucking action of the gas compressors, and where, by its evaporation, it absorbs heat from the brine surrounding the evaporating-coils, and thus reduces the temperature of the brine.

Gas compressors may be single or double acting. A great difficulty in pumps of this kind, particularly those which handle gases of the tenuity of ammonia, has always been found in keeping the stuffing-box tight. To take away from the stuffing-box the high pressure of the condenser, which always occurs at the end of each stroke in a double-acting compressor, single-acting compressors have been resorted to, which carry only the lower pressure of the suction side over the stuffing-box, thus reducing the chance of leakage. But it is apparent that a double-acting compressor is more advantageous, providing it is well constructed, because it handles double the amount of gas with every revolution of the crank-shaft that a single compressor does which has the same diameter and same stroke. The moving parts, such as cross-head, piston, piston-rod, and connecting-rod, being the same for either a double or a single acting compressor, the *friction will be the same for all these parts while double the work is being effected.* To overcome friction means power expended, *power*

wasted, and in our case, viz., in a machine with two gas compressors, it means a saving of one-eighth of the whole power used for compressing the gas. Another advantage is the cheapening of the machine through the fact that one double-acting compressor will do the work of two single-acting ones of the same size.

Our first compressor, which we have built up to about one year ago, was a single-acting compressor. In connection with it we have used our patented system of the circulation of oil, which was intended to lubricate the piston and piston-rod, to effectually seal the stuffing-box, piston, and all valves, and cool the gas during compression. An experience of ten years has proved this system so immensely successful that we consider it one of the most valuable features of our machine.

In attempting to construct a double-acting compressor, this oil circulation proved a serious drawback to the proper discharge of the gas on the lower side of the piston; and still we could and would not give it up, because this would have meant an inferior pump. In the ordinary form of double-acting vertical compressors the discharge-valves at the lower end are placed either on the side or in the lower head. In either case the oil is discharged on the down stroke *before* all the gas has left the pump; and this is wrong. The oil must be discharged *after* all the gas is gone, because otherwise re-expansion takes place, and this means loss of efficiency of the pump. We have avoided this difficulty in the following manner:

At the lower end of the compressor there are two discharge-valves placed on the side, one above the other. On the down stroke either of the valves, or both, may open until the piston covers the upper one, when only the lower one is open to the condenser. In the further course of the piston, and as soon as the lower valve is also closed, the upper one is in communication with an annular chamber contained in the piston. This chamber has valves in its bottom, which open into it as soon as all other outlets from the lower side of the piston are closed (they open a little harder than the discharge-valves on the side), and now the gas will all go out through the piston; and after the gas the oil will follow, thus permitting no gas to remain on the lower side after the completion of the down stroke. It will be seen that in

this manner the very important oil-system of our machine is retained, and that the lower side of the pump works as well as the upper, while the oil effectually seals the stuffing-box in spite of the higher pressure on it at the end of the down stroke.

In Plate 2 our old style of single-acting compressor is shown, and in Plate 3 the new double-acting, for which a patent has been granted to Mr. Louis Block, of our company. The machines with double-acting pumps which have been in operation, some of them nearly two years, have all worked to our utmost satisfaction, and we are now recommending them as superior to the single-acting machines on account of the saving in power and greater cheapness.

DIFFERENT SYSTEMS OF ICE-MAKING.

In the application of a machine for making ice, it seems that this art may aptly be divided into two grand systems, the one using brine for the purpose of freezing water, the other effecting the freezing by direct expansion, the same as in refrigerating plants.

It is clear that it avoids a great deal of superfluous apparatus, of loss in efficiency and of untidiness, if the cooling or freezing is done directly without the interpolation of brine. Experimenters have for this reason tried to do away with brine in ice-making, as it has been abolished in the refrigeration of rooms. But here much greater obstacles have been met than in cooling-plants. Given a good pipe-system, and refrigeration by direct expansion has no difficulties whatsoever. Where, however, water has to be solidified, the first drawback met is the necessity of straight surfaces. A wrought-iron pipe of no excessive diameter is the safest and cheapest means of confining ammoniacal gas, but if ice is formed around the pipes it becomes a matter of great wastefulness and trouble to loosen it again from the pipes. Straight surfaces are very difficult to construct and to keep tight, and all attempts to do this have been failures so far. Another proposition to freeze water without the use of brine has been to imitate nature, viz.: to produce temperatures below the freezing-point in well-insulated rooms. But here the low specific heat of air, and its low degree of conductibility, proved such a great obstacle that the cooling surfaces of the rooms had to be made excessively large, and still

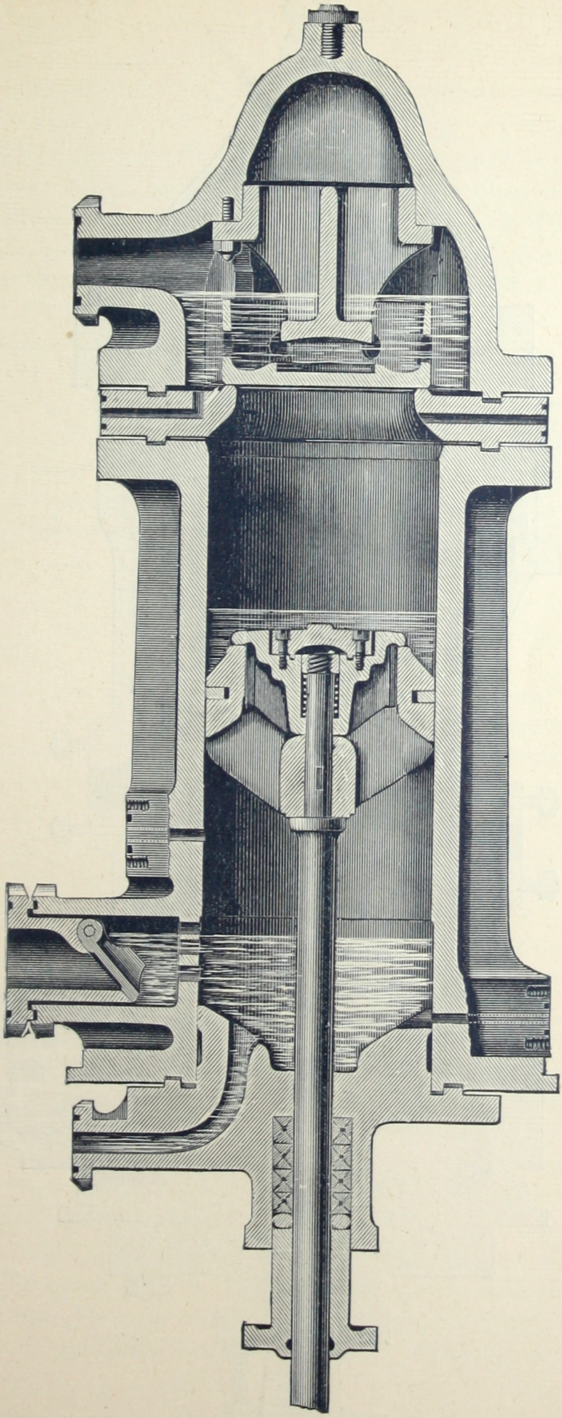


PLATE 2.—Sectional View of Single acting Compressor.

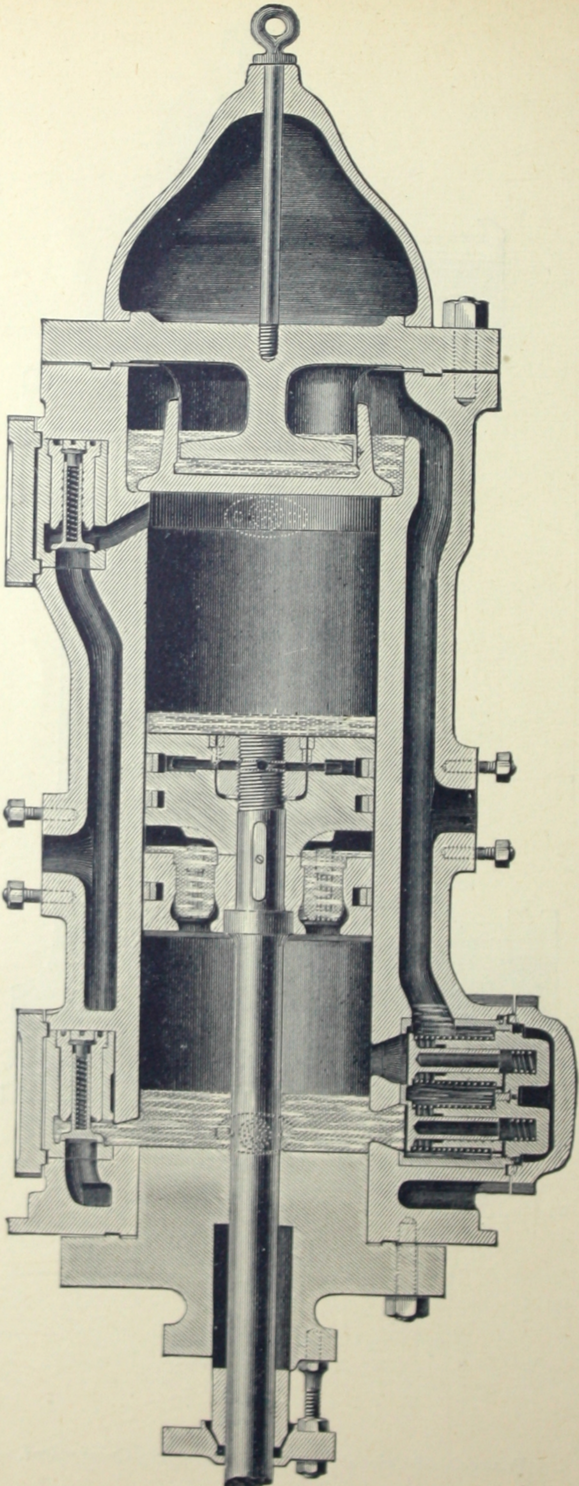


PLATE 3.—Sectional View of Double-Acting Compressor.

the result was extremely slow freezing. Still another form of ice-machine is one which freezes the water *in vacuo* without the use of either brine or any other agent than the water itself. If water is exposed to an almost absolute vacuum it turns rapidly into vapor, the transformation requiring so much heat, which is furnished by the water itself, that the balance of the water which is not vaporized freezes solid. The ice thus formed, however, is totally unfit for the market, being in the shape of granulated snow, full of air, brittle, and of no durability. This process was first proposed and introduced for the freezing of carafes by E. Carré (not the inventor of the absorption-machine), and afterward carried out on a large scale by F. Windhausen in Germany in his vacuum ice-machine. The system, however, was not a successful one, partly on account of the poor quality of the ice, partly because the sulphuric acid, which was used as an auxiliary to the air-pump to carry away the aqueous vapor by absorption, caused great trouble in its process of reconcentration.

The small success which attended all the attempts at ice-making without brine brought inventors back to the use of brine, and the different processes of to-day all use this otherwise undesirable commodity.

In its application the system of making ice by the use of brine is quite varied, but, on the whole, three different modes have, up to this day, established themselves in the market:

First, The system of removable cans.

Second, The plate system.

Third, The system of stationary cells.

The first is the one most in use the world over. In an iron or wooden tank, well insulated, a salt-brine is kept at a temperature considerably below the freezing-point of water by evaporating-coils, which are connected to the gas-pump, if the machine is a compression-machine, or to the absorber if the machine is an absorption-machine. In this brine galvanized iron cans are immersed. They contain the water to be frozen, and it is evident that in the course of time a coating of ice will form on the bottom and on the sides of the cans, and that after sufficient time has elapsed a solid block of ice will thus be produced in each can. One can after another is now lifted out of the brine or freezing-tank, dipped into or sprinkled with tepid water, whereby the ice is

loosened from the can, and the block slipped out, the can again filled with fresh water, and replaced in its position in the tank, where the freezing is again taken up. Thus a continuous process is established which permits of a regular output throughout the day and night.

In the plate system, which as a rule produces ice in pieces weighing one or more tons, a hollow plate of boiler-iron is formed and immersed in a tank containing fresh water to be frozen. This plate is filled with brine, which is kept below the freezing-point by evaporating-coils in a manner similar to those of the can system. The coils may be either in the plates or outside in a separate brine-tank, and the brine circulated through the plate. By thus keeping the plate at a sufficiently low temperature ice will form on both sides of it, and by and by two layers of ice will be built up on the two sides of the plate. In order to remove this ice, the cold brine is drawn from the plates, and in case the evaporating-coils are inside of the plates the circulation of ammonia in them is stopped. Now tepid brine is supplied to the hollow plates, and after a short while the ice is loosened from them, and can be hoisted out of the tank by means of cranes, and cut up into blocks of any desired size. A number of plates are as a rule immersed into each tank, and a whole tank emptied at one time. In order to make the process continuous, more than one tank must be supplied, so that one at least is in continuous operation, while the other is being emptied and refilled and prepared again for work. But on larger plants even more than two tanks are necessary to permit of a daily drawing of ice. The freezing process going on from one side only, *i. e.*, a certain thickness of ice being formed by building up only on one side, the time of freezing is necessarily long. In a can ice is formed on two opposite sides, and the two surfaces growing together in the centre will ultimately make a solid block equal in thickness to the width of the can. If ice of such thickness is made on a plate, frozen only from one side, it takes about four times as long. Nevertheless the plate system has certain advantages, to which we will recur later on.

In the system using stationary cells the cold brine is pumped through the hollow walls of the cells, the latter being open at the top, and filled nearly brimful with the fresh water to be frozen.

Ice will form in the cells the same as in the can system. After the blocks are finished in the cells, tepid brine is pumped in place of the cold brine, and thereby the ice loosened from the cells, and its removal becomes a matter of little time. It is self-evident that in this system a whole tank has to be emptied at the same time as in the plate system, and, to make the plant continuous in its operation, more than one tank has to be employed. If the cells are made quite deep in proportion to their width, similar to the cans used in the can system, then of course the freezing-time is as fast as in the system first described. But if shallow cells, pan-shape, are used, the depth being small in proportion to length and width, then the freezing will practically be done mostly from the bottom, and for the same thickness of ice the time of freezing will be quadrupled as in the plate system. There is an object in using either the deep or the shallow cell, as will be shown later on.

TRANSPARENT ICE.

IN the beginning of the industry of ice-making, many manufacturers were satisfied with producing an article regardless of quality. Therefore no special pains were taken to make transparent ice, but by and by the demands for a better product were made. At first, freezing at comparatively high temperatures was resorted to, by which at least one part of the block becomes clear. But, then, the time of freezing was so slow, and it took such a large number of cans and large tanks, and the first cost of the plant came to be so high, that means were tried to make the ice faster, freezing it at lower temperatures and still making it clear.

Quite a number of inventions were made to obtain this object, all of which were more or less successful. One thing was soon discovered: that clear ice could be produced by agitating the water during the process of freezing; and the different propositions to accomplish this are quite numerous. A metal bar was let into the can and lifted up and down by a small revolving shaft and thumb, or a crank; or a wooden paddle was inserted into the can and moved to and fro by some kind of mechanism; or a small perforated pipe was introduced into the can within a few inches from the bottom, and a current of cold air forced through the pipe,

rising in bubbles through the water and emerging at the top, thereby producing a circulation in the can. All of these arrangements had the disadvantage that at the end of the operation of making the ice-block, the bar, paddle, or pipe had to be removed to prevent being frozen into the ice, while otherwise the effect was good. Another proposition was to rock the can in the tank, thus agitating the water. None of these different arrangements, however, found favor in practical use. The moving-gear for many hundreds, even thousands, of cans proved quite cumbersome. In removing the cans from the tanks this gear was in the way, and had likewise to be removed, and, on the whole, few and comparatively small plants have adopted either one system.

The plate system and the shallow stationary cells alone avoided the agitation of the water, and yet produced clear ice. But the freezing taking place only from one side, the process was so slow, and the plants became so large and expensive, that these systems also have found few users.

Another mode of making transparent ice is to deprive the water of its air before it goes into the cans. This can be done by long-continued boiling, or by exposing the water to a high vacuum, but better still by distillation under exclusion of the atmosphere. The result of this process has been found extremely satisfactory, and is to-day the one most in use. In order to economize in fuel, however, it has been found necessary to use the exhaust steam from the engine for the purpose of ice-making; and the steam, therefore, had to be deprived of the oil used in lubricating the steam-cylinder. This has effectually been accomplished by steam-filters of very simple construction. After condensation of the steam thus filtered, the condensed water is again filtered in order to entirely deodorize it. As a result, can-ice produced in this manner is as good as ice can be made. It contains but a very thin stratum of porous ice in the centre, due to reabsorption of air in the can during freezing, but it is better and purer and more durable than any natural ice which can be bought. The ice is obtained in rectangular blocks of any desired size, and the waste by melting out of the moulds reduced to a minimum.

The constantly increasing demand for "hygienic" ice brings the necessity of artificial ice more and more in the foreground; and this circumstance, together with the fact that such ice can be

produced economically, has resulted in the great impetus which the establishing of ice-factories is now receiving. The constantly increasing contamination of the water-sources in the neighborhood of large cities, from which ice is harvested, brings with it great dangers to the health of the communities, and the sanitary boards of cities and health-resorts have of late given the question of ice-consumption considerable attention.

DESCRIPTION OF THE DE LA VERGNE ICE-MAKING PLANT.

In the appended woodcut, plate 4, the arrangement of our ice-making plant is shown, the whole spread out on one sheet to facilitate following the circulation of the ammonia, the oil, the steam, etc., without being compelled to refer to different views, whereby the layman is easily misled. It will be understood that the different parts may be placed in relatively different positions to each other, as long as the principle of the system is not thereby disturbed.

Let us first follow the circulation of the ammonia through the system and learn how the cold is produced which ultimately freezes the water.

We will begin at the compressor, which is shown to be a double-acting one and marked *A*. On the right-hand side the gas is drawn from the evaporating-coils through the suction-pipe *B*. By the action of the compressor the gas is discharged through the pipe *C* into the pressure tank *D*, where the oil, which we will follow later on, is dropped to the bottom. The upper half of this tank is provided with cast-iron baffle-plates, which serve to more completely retain the oil and lodge it on the bottom. From the tank the gas, still hot by its compression, is sent through pipe *E* into the bottom pipe of the condenser *F*, where, by the action of cold water running over the pipes, the hot gas is first cooled, and then liquefied. The small liquid pipes *G* conduct the liquid ammonia through the liquid header *H* into the storage tank *I*, and from there it runs through the pipe *J* into the bottom of the separating-tank *K*, which should be at all times at least three-quarters full. The small pipe *L* carries the liquid ammonia, in

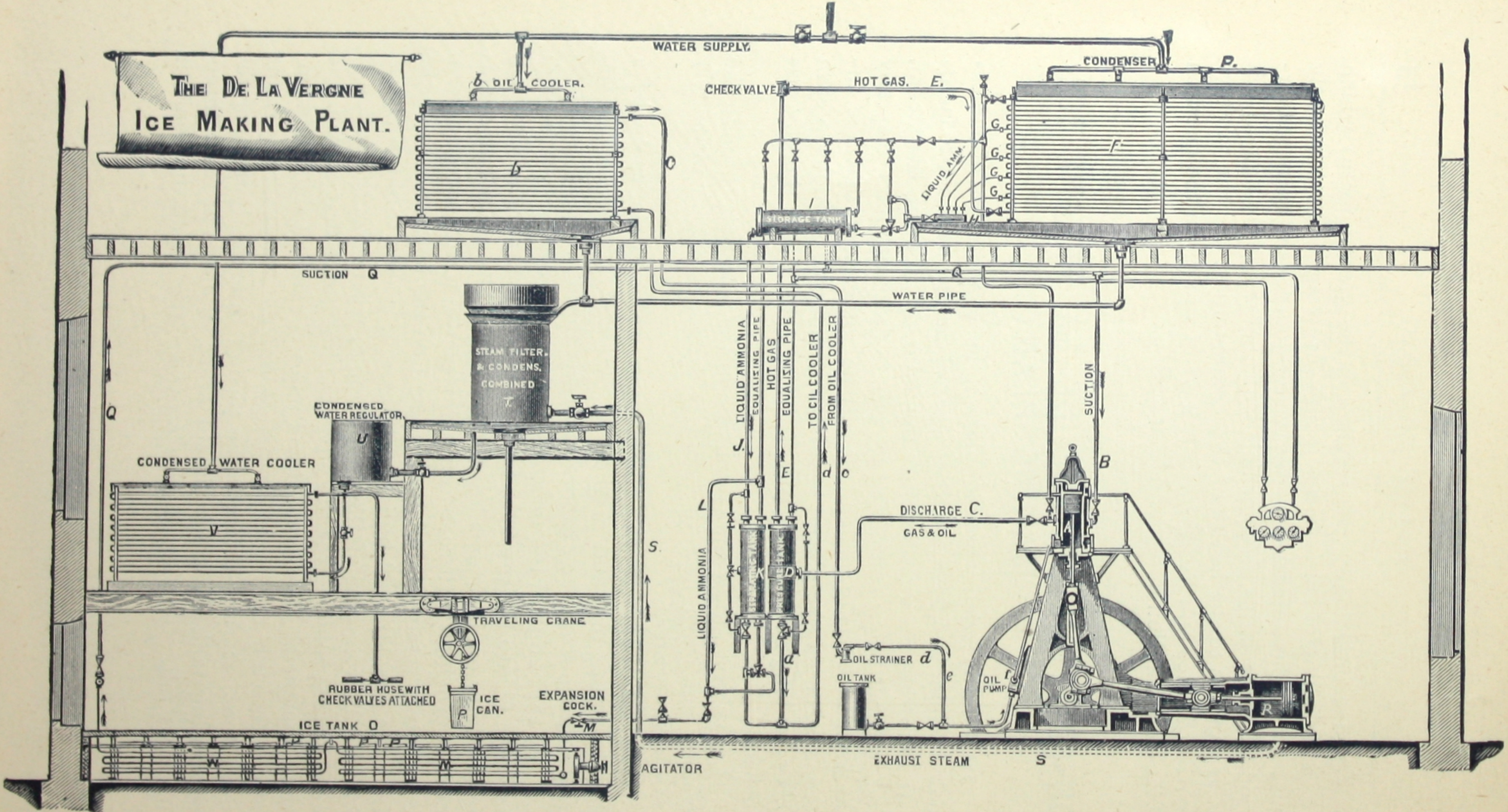


PLATE 4.—The De La Vergne Ice-Making Plant.

consequence of the pressure on it, to the expansion-cock *M*, through which it is injected into the evaporating-coils *N*, placed in the freezing-tank *O*. This tank contains a salt-brine, non-congealable except at a temperature near zero; and by the absorption of heat from this brine the ammonia, in vaporizing, cools it down to a temperature below 32°, say 17° or 18°. Of the coils *N* there are a number side by side, leaving space enough between them to insert the galvanized iron ice-cans *P*, which contain the water to be frozen. After evaporating in the coils *N*, and thereby having taken up heat from the brine, the ammonia-gas now passes through the pipes *Q* and *B* back into the compressor from which we started. This is the entire cycle through which the ammonia passes.

In the description of our compressor on page 7 we mentioned our patented system of oil-circulation. This we will now take up.

We found that the oil heated with the gas by compression was dropped into the bottom of tank *D*. From there it passes through the pipe *a* to the lowest pipe of the oil-cooler *b*, similar in construction to the condenser, and, like it, cooled by cold water showered over it. After being cooled down in the oil-cooler it passes through pipe *c*, strainer *d*, and pipe *e*, into the oil-pump *f*, which is so constructed that it distributes the cold oil into the compressor on either side of the piston during its compression stroke, *i. e.*, in such a manner that no oil is furnished during the suction stroke of the piston, but only during the time of compressing, thereby cooling the gas during its period of heating. The hot oil after leaving the compressor now returns again in company with the hot gas to the tank *d*, and from there again enters on its course through the oil-cooler, strainer, and oil-pump to the compressor.

It will be seen that both the ammonia and oil go through complete cycles, and that no waste of either will occur except by leakage. In case, however, small traces of oil are carried along with the current of the gas from the pressure tank *D* into the condenser *F*, these small quantities flow along with the liquid ammonia into the separating-tank *K*, where they collect at the bottom, the oil being heavier than liquid ammonia. When a certain amount of oil has collected here it can be drawn off through the

cock *g* and pipe *h*, and carried through the oil-cooler back into the oil-pump and compressor.

The steam from the steam cylinder marked *R* passes through the exhaust pipe *S* into the steam-filter and condenser *T*, where it is purified and condensed. Out of the condenser T it runs into the water-regulator tank *U*, from there through the condensed-water-cooling coil *V*, constructed like the ammonia condenser and oil-cooler, and cooled by cold water, and is ultimately filled into the ice-cans through rubber hose and cocks. After the cans have their contents frozen, the traveling crane transports them to the dip-tank or sprinkler, where the block is melted out. The empty can is put back into its position in the freezing-tank, re-filled with water, and the process of making another block is commenced.

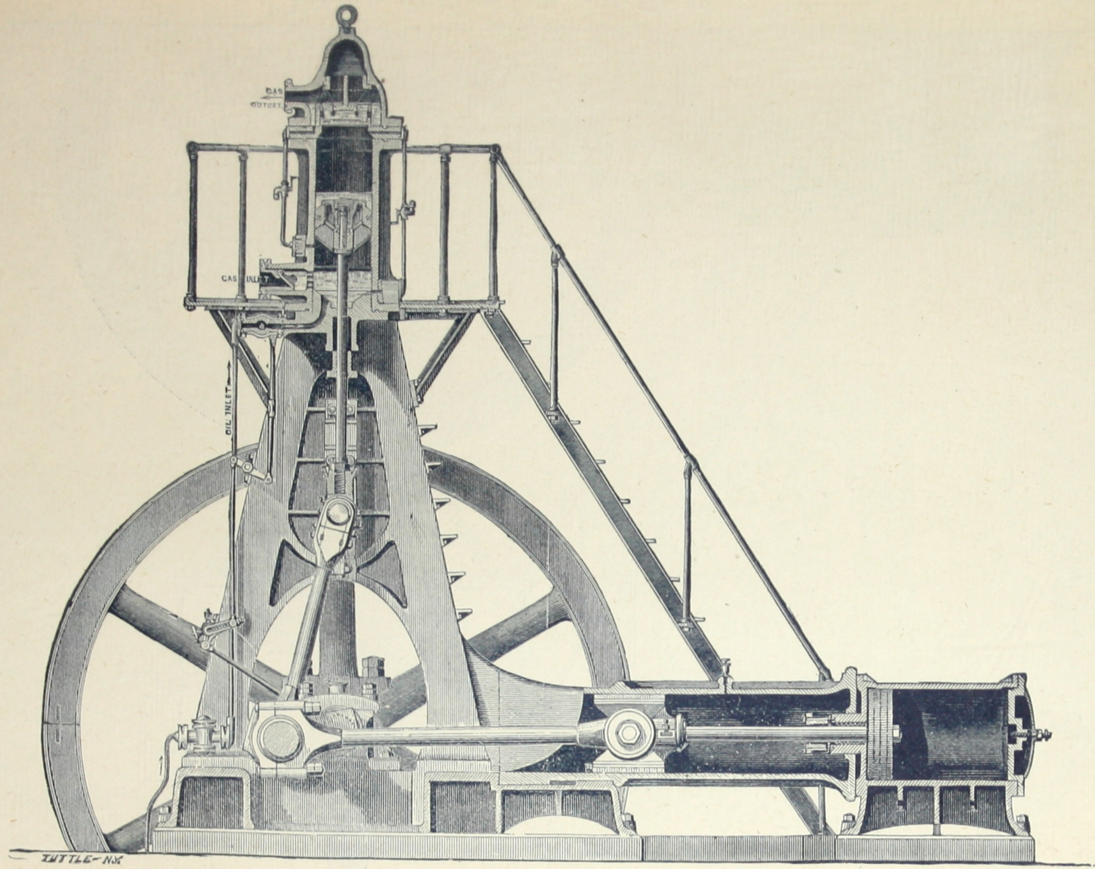


PLATE 5.—Sectional View of Single-Acting Machine.

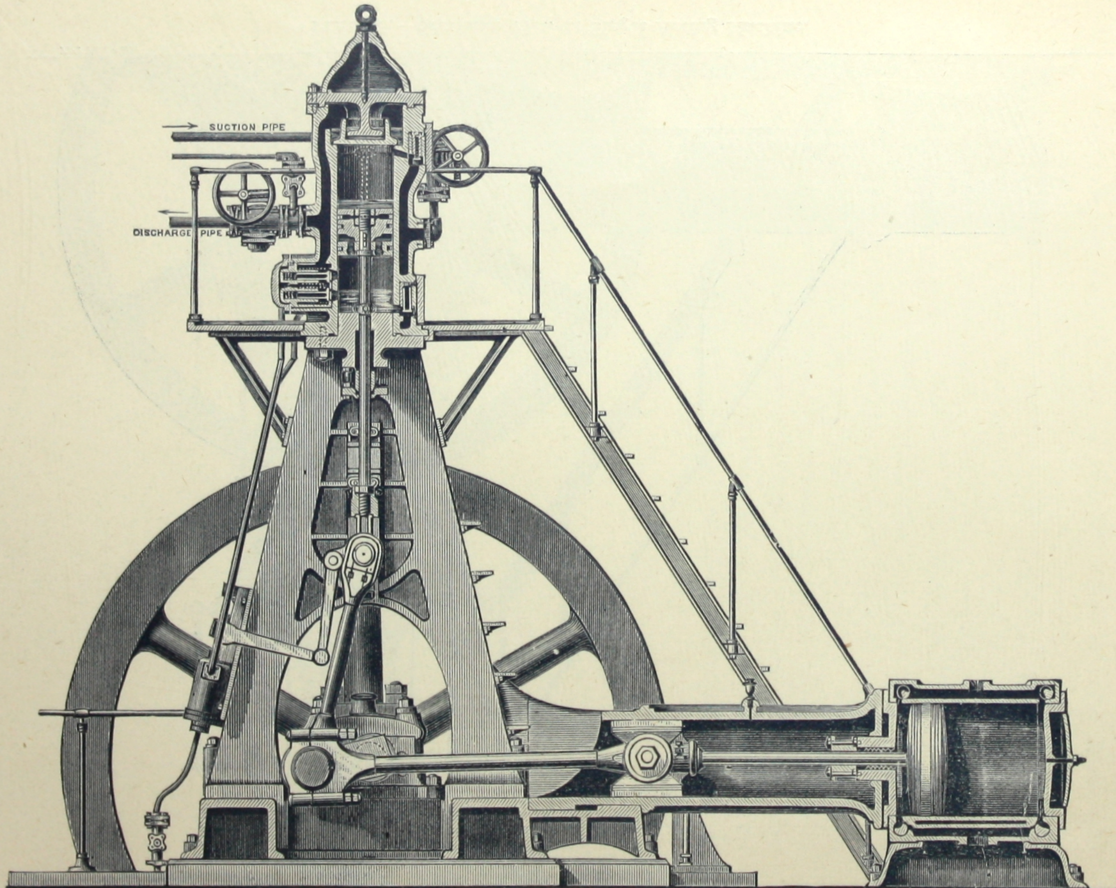
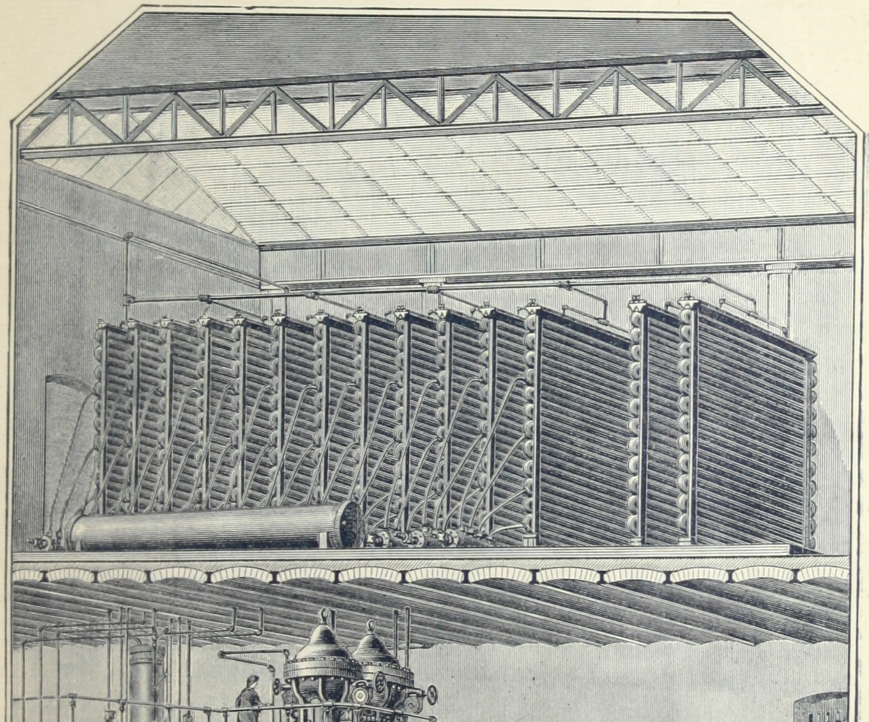


PLATE 6.—Sectional View of Double-Acting Machine.



220 TON REFRIGERATING MACHINE.

PLATE 7.—130 Ton Ice-Machine.

REMARKS.

In concluding this short description we should say a word regarding the construction of our pipe system and the workmanship of our plant.

One of the principal shortcomings of the cheap machines offered in the market is the defective construction of the compressors and the pipe system. The so-called "dry" compressors, *i. e.*, those using only small quantities of oil simply for lubrication, require water-jackets to cool them. The result is that the water-cooling only benefits the walls of the compressor, preventing its too rapid wear and tear, while it does not reduce the temperature of the gas during compression to any perceptible degree. Hence the discharge-valves become hot, and they and the steel springs that hold them down are fast giving out. The sealing of the stuffing-box, piston, and valves can only be accomplished by large quantities of oil—large in proportion to those used for lubrication only. Complicated and delicate arrangements for the adjustment of the stuffing-boxes have been resorted to, to keep them tight and avoid great friction around the piston-rods. Our stuffing-box is of the simplest kind, with hemp packing or metallic packing, which latter, if well attended to, is almost indestructible, but we have used even common hemp packing in our compressors for two years. On account of the excellent lubrication which we obtain by the large quantities of oil injected, the cooling of all parts of the compressor, and the sealing of all joints and other details apt to leak, we have produced a compressor which will last longer than any other one without requiring reboring; and it is a fact, which will stand investigation, that all our compressors work as well to-day, or even better than when they were started—and some of them are now ten years old. The oil being the sealing medium, all packings are quite free; hence the insignificant wear of all the parts of the gas-pump. All our compressors still show the tool marks which they possessed after leaving the shop, and this cannot be said of any other gas compressor in the market.

Another very important feature in all machines using ammonia, or any other gas of great tenuity, is the good construction of the pipe system, including all joints, fittings, cocks, or valves. If they are not of the very best construction and workmanship, leakages are frequent; and ammonia is a costly agent to replace. Machines are to-day running whose ammonia consumption amounts to thousands of dollars every year. The joint in our pipes, which we have patented, is a screwed and soldered joint of peculiar construction, and we know that it is even more durable and safe than the pipes themselves. The cocks are likewise of a construction which permits of no grit or impurities entering between the plug and the housing, and they also last longer than any other style in existence. All parts exposed to the pressure of the ammonia are tested to 1,000 pounds in our works, and they afford the greatest possible degree of safety against leakage or breakage. Any one wishing more detailed information on this point, we take pleasure in referring to our illustrated catalogue, which we will mail on application.

The sizes of ice-machines we are prepared to furnish range from a capacity of one ton of ice per day to 130 tons per day. Plants of over 130 tons require more than one machine. With a large number of patterns on hand now, we can furnish almost any size; but, of course, it may be necessary, for just one certain production per day, to furnish a machine somewhat larger than is needed. That is to say: we can build the freezing-tank system of any size which may be wanted, but the compressors might have to be somewhat larger than necessary to manufacture just this amount of ice. In this case there is spare capacity left in the compressors for refrigerating purposes or for a future increase in the ice output.

We shall at all times be pleased to furnish estimates for ice-plants, also to give any information we may possess, free of charge.

THE DE LA VERGNE REFRIGERATING MACHINE CO.

Foot of East 138th Street, NEW YORK CITY.

Those Desiring an Estimate for the Cost of a Plant will Please Note the Following:

1st. State the number of tons of ice required as a daily production.

2d. Whether you want clear, pure ice, or whether you are satisfied with opaque ice, made directly from the water at your disposal without purification.

3d. Character, quantity, and temperature of water at your disposal.

4th. Whether you desire an estimate for the steam-boiler plant also. Or if you have steam-power on your premises, state how many horse-power you have to spare.

5th. If you want to locate the plant in buildings in existence, send diagram of same.

6th. If you wish us to give you an estimate on the cost of running an ice-plant, state how many tons you want to make per day, cost of fuel and quality, wages for engineers, firemen, and common laborers, for twelve hours' day-work and twelve hours' night-work. Also what the cost of water would be in case you have to pay for it.

THE sizes of machines for which we now have the patterns, and which may be ordered from us at any time, are the following:

MACHINES WITH SINGLE-ACTING COMPRESSORS.

Compressors.	Steam Cylinders.	Horse-power required.	Capacity of Machines in Ice Melted every 24 hours.	Capacity of Machines in Ice Manufactured every 24 hours.
One 6 x 10	One 7 x 10	3 H.-P.	2 Tons.	1 Ton.
Two 6 x 12	" 9 x 12	6 "	4 "	2 Tons.
" 8 x 16	" 12 x 16	13 "	9 "	5 "
" 9 x 16	" 13 x 16	17 "	12 "	7 "
" 10 x 20	" 16 x 20	25 "	18 "	10 "
" 12 x 24	" 18 x 24	47 "	35 "	20 "
" 14 x 28	" 22 x 28	66 "	50 "	30 "
" 16 x 32	" 26 x 32	100 "	75 "	45 "
" 18 x 36	" 32 x 36	140 "	110 "	65 "

MACHINES WITH DOUBLE-ACTING COMPRESSORS.

Compressors.	Steam Cylinders.	Horse-power required.	Capacity of Machines in Ice Melted every 24 hours.	Capacity of Machines in Ice Manufactured every 24 hours.
One 6 x 10	One 9 x 10	6 H.-P.	4 Tons.	2 Tons.
Two 6 x 12	" 12 x 12	12 "	9 "	5 "
" 8 x 16	" 16 x 16	23 "	18 "	10 "
" 9 x 18	" 18 x 18	31 "	25 "	15 "
" 10 x 20	" 20 x 20	42 "	35 "	20 "
" 11 x 22	" 22 x 22	60 "	50 "	30 "
" 12 x 24	" 24 x 24	77 "	65 "	40 "
" 14 x 28	" 28 x 28	119 "	100 "	60 "
" 16 x 32	" 32 x 32	180 "	150 "	90 "
" 18 x 36	" 36 x 36	250 "	220 "	130 "

The above capacities are based on 40 revolutions per minute.

LIST OF CUSTOMERS.

January 1, 1890.

The De La Vergne Refrigerating Machine Co.,

Foot of East 138th Street, NEW YORK CITY.

BREWERIES.

Name.	Address.	Number of Machines.	Total Refrigeration.	Year of Completion.
Jacob Ruppert	New York	One 110-ton	=110 tons	1884
Jacob Ruppert—Second Order	New York	Two 110 "	220 "	1885
George Ehret	New York	One 110 "	110 "	1885
George Ehret—Second Order	New York	Two 110 "	220 "	1885
William J. Lemp	St. Louis, Mo.	Two 110 "	220 "	1888
William J. Lemp—Second Order	St. Louis, Mo.	One 110 "	110 "	1889
Bernheimer & Schmid	New York	One 220 "	220 "	1888
†Anheuser-Busch Brewing Ass'n	St. Louis, Mo.	One 110 "	110 "	1886
Anheuser-Busch Brewing Ass'n—Second Order	Kansas City, Mo	One 12 "	12 "	1886
†Anheuser-Busch Brewing Ass'n—Third Order	St. Louis, Mo.	One 110 "	110 "	1189
Anheuser-Busch Brewing Ass'n—Fourth Order	Dallas, Texas	One 4 "	4 "	1889
(For Fifth and Sixth orders from Anheuser-Busch Brewing Association, see Artificial Ice Plants.)				
Budweiser Brewing Co., Lim'd	Brooklyn, N. Y.	One 110 "	110 "	1886
*L. Schlather Brewing Co	Cleveland, Ohio	One 110 "	110 "	1888
Hinckel Brewing Co	Albany, N. Y	One 100 "	100 "	1889
Joseph Schlitz Brewing Co.—First Order	Memphis, Tenn.	One 4 "	4 "	1886
Joseph Schlitz Brewing Co.—Second Order	Milwaukee, Wis.	One 100 "	100 "	1890
Eberhardt & Ober Brewing Co.	Pittsburgh, Pa.	One 100 "	100 "	1890
†Hyde Park Brewery Co	St. Louis, Mo	One 75 "	75 "	1886
†Pabst Brewing Co	Milwaukee, Wis.	One 75 "	75 "	1886
*John Wieland Brewing Co	San Francisco, Cal.	One 75 "	75 "	1889
Falk, Jung & Borchert Brewing Co.	Milwaukee, Wis.	One 75 "	75 "	1889
Ballantine & Co	Newark, N. J.	One 64 "	64 "	1882
Ballantine & Co.—Second Order	Newark, N. J.	One 110 "	110 "	1886
Ballantine & Co.—Third Order	Newark, N. J.	Two 100 "	200 "	1890
†Bergner & Engel Brewing Co	Philadelphia, Pa.	One 50 "	50 "	1884
†Bergner & Engel Brewing Co.—Second Order	Philadelphia, Pa.	One 50 "	50 "	1885
†Bergner & Engel Brewing Co.—Third Order	Philadelphia, Pa.	One 110 "	110 "	1888
†Bartholomay Brewing Co	Rochester, N. Y.	One 50 "	50 "	1886
Bartholomay Brewing Co.—Second Order	Rochester, N. Y.	Two 50 "	100 "	1887

Name.	Address.	Number of Machines.		Total Refrigeration.	Year of Completion.
Rochester Brewing Co	Rochester, N. Y.	One	50-ton. .=	50 tons. .	1888
Rochester Brewing Co. — Second Order	Rochester, N. Y.	One	100 " ..	100 " ..	1889
Z. Wainwright Brewing Co	Pittsburgh, Pa.	Two	65 " ..	130 " ..	1890
Macon Brewing Co	Macon, Ga	Two	65 " ..	130 " ..	1890
S. Liebmann's Sons	Brooklyn, N. Y.	Two	50 " ..	100 " ..	1883
Wainwright Brewery Co	St. Louis, Mo.	Two	50 " ..	100 " ..	1884
Rubsam & Horrman	Staten Island	Two	50 " ..	100 " ..	1885
Conrad Stein	New York	Two	50 " ..	100 " ..	1886
Beadleston & Woerz	New York	Two	50 " ..	100 " ..	1885
*Jacob Hoffmann Brewing Co.	New York	Two	50 " ..	100 " ..	1887
J. & P. Baltz Brewing Co	Philadelphia, Pa.	Two	50 " ..	100 " ..	1887
Leonhard Eppig	Brooklyn, N. Y.	Two	50 " ..	100 " ..	1887
Crescent City Brewing Co	New Orleans, La	Two	50 " ..	100 " ..	1888
Louis Bergdoll Brewing Co	Philadelphia, Pa.	One	64 " ..	64 " ..	1882
Louis Bergdoll Brewing Co.—Second Order	Philadelphia, Pa.	Two	50 " ..	100 " ..	1885
The Bartholomae & Leicht Brewing Co	Chicago, Ill.	Two	50 " ..	100 " ..	1889
Otto Huber	Brooklyn, N. Y	Two	35 " ..	70 " ..	1881
Otto Huber—Second Order	Brooklyn, N. Y.	One	50 " ..	50 " ..	1885
Gottfried Krueger	Newark, N. J	Two	35 " ..	70 " ..	1883
Gottfried Krueger—Second Order	Newark, N. J	One	50 " ..	50 " ..	1885
Burr, Son & Co	New York	Two	35 " ..	70 " ..	1880
Obermeyer & Liebmann	Brooklyn, N. Y	Two	35 " ..	70 " ..	1884
Peter Hauck & Co	Newark, N. J.	Two	35 " ..	70 " ..	1884
Christian Schmidt	Philadelphia, Pa.	Two	35 " ..	70 " ..	1885
†A. Finck & Son	New York	Two	35 " ..	70 " ..	1885
Franz J. Kastner	Newark, N. J.	Two	35 " ..	70 " ..	1885
Christian Weyand	Buffalo, N. Y	Two	35 " ..	70 " ..	1886
C. Trefz	Newark, N. J.	Two	35 " ..	70 " ..	1886
J. H. Von der Horst & Son	Baltimore, Md.	Two	35 " ..	70 " ..	1886
Monroe Eckstein	Staten Island	Two	35 " ..	70 " ..	1887
M. Groh's Sons	New York	Two	35 " ..	70 " ..	1887
Weckerling Brewing Co	New Orleans, La.	Two	35 " ..	70 " ..	1888
Pelican Brewing Co	New Orleans, La.	Two	35 " ..	70 " ..	1888
Frederick Koehler & Co	Erie, Pa.	Two	35 " ..	70 " ..	1890
Suffolk Brewing Co	Boston, Mass.	One	65 " ..	65 " ..	1890
American Brewing Co	Chicago, Ill.	One	65 " ..	65 " ..	1890
Northwestern Brewing Co	Chicago, Ill.	One	65 " ..	65 " ..	1890
H. B. Scharmann	Brooklyn, N. Y.	One	50 " ..	50 " ..	1883
H. B. Scharmann—Second Order	Brooklyn, N. Y.	One	50 " ..	50 " ..	1888
Claus Lipsius	Brooklyn, N. Y.	One	50 " ..	50 " ..	1883
Claus Lipsius—Second Order	Brooklyn, N. Y.	One	50 " ..	50 " ..	1885
William Ulmer	Brooklyn, N. Y.	One	50 " ..	50 " ..	1886
William Ulmer—Second Order	Brooklyn, N. Y.	One	50 " ..	50 " ..	1886
H. & J. Paff	Boston, Mass.	One	50 " ..	50 " ..	1884
H. & J. Paff—Second Order	Boston, Mass.	One	50 " ..	50 " ..	1885
Henry Muller	Philadelphia, Pa.	One	50 " ..	50 " ..	1884
Henry Muller—Second Order	Philadelphia, Pa.	One	50 " ..	50 " ..	1886
Ph. Zang & Co	Denver, Col.	One	50 " ..	50 " ..	1886
Ph. Zang & Co—Second Order	Denver, Col.	One	50 " ..	50 " ..	1887
*Jos. Schnaider's Brewing Co	St. Louis, Mo	One	50 " ..	50 " ..	1886
*Jos. Schnaider's Brewing Co.—Second Order	St. Louis, Mo	One	50 " ..	50 ..	1887
*H. Grone Brewery Co	St. Louis, Mo	One	50 " ..	50 ..	1886
*H. Grone Brewery Co.—Second Order	St. Louis, Mo	One	50 " ..	50 " ..	1888

Name.	Address.	Number of Machines.		Total Refrigeration.	Year of Completion.
Jung Brewing Co	Cincinnati, O	One	50-ton..	= 50 tons	1886
Jung Brewing Co—Second Order	Cincinnati, O	One	50 " ..	50 "	1886
Christian Heurich	Washington, D. C	One	50 " ..	50 "	1885
John Roessle	Boston, Mass	One	50 " ..	50 "	1885
†H. Clausen & Son Brewing Co	New York	One	50 " ..	50 "	1887
B. Stroh Brewing Co	Detroit, Mich	One	50 " ..	50 "	1887
Fred. Miller Brewing Co	Milwaukee, Wis	One	50 " ..	50 "	1887
Fred. Miller Brewing Co.—Second Order	Milwaukee, Wis	One	50 " ..	50 "	1889
A. Griesedieck Brewing Co	St. Louis, Mo	One	50 " ..	50 "	1888
*Haffenreffer & Co	Boston, Mass	One	50 " ..	50 "	1888
Valentine Loewer	New York	One	50 " ..	50 "	1883
Ziegele Brewing Co	Buffalo, N. Y	One	50 " ..	50 "	1888
National Brewing Co	San Francisco, Cal	One	50 " ..	50 "	1889
Jacob Ahles Brewing Co	New York	One	50 " ..	50 "	1889
Buffalo Brewing Co	Sacramento, Cal	One	50 " ..	50 "	1889

(For second order from Buffalo Brewing Co., see Artificial Ice Plants.)

William Peter	Union Hill, N. J	One	50 " ..	50 "	1890
D. M. Lyon & Sons	Newark, N. J	One	50 " ..	50 "	1890
United States Brewing Co	San Francisco, Cal	One	50 " ..	50 "	1890
Peter Buckel	New York	One	35 " ..	35 "	1889
George Zett	Syracuse, N. Y	One	35 " ..	35 "	1889
Hubert Fischer	Hartford, Conn	One	35 " ..	35 "	1889
Grasser & Brand Brewing Co	Toledo, O	One	35 " ..	35 "	1889
Ferd. Munch	Brooklyn, N. Y	One	35 " ..	35 "	1882
Ferd. Munch—Second Order	Brooklyn, N. Y	One	35 " ..	35 "	1884
Continental Brewing Co	Philadelphia, Pa	One	35 " ..	35 "	1883
Continental Brewing Co.—Second Order	Philadelphia, Pa	One	35 " ..	35 "	1884
C. Feigenspan	Newark, N. J	One	35 " ..	35 "	1884
C. Feigenspan—Second Order	Newark, N. J	One	35 " ..	35 "	1884
Wm. Hill	Newark, N. J	One	35 " ..	35 "	1886
Wm. Hill—Second Order	Newark, N. J	One	35 " ..	35 "	1884
Chas. A. King	Boston, Mass	One	35 " ..	35 "	1886
J. Chr. G. Hupfel Brewing Co	New York	One	35 " ..	35 "	1884
J. Chr. G. Hupfel Brewing Co.—Second Order	New York	One	35 " ..	35 "	1886
Ernst Bros. Brewing Co	Chicago, Ill	One	35 " ..	35 "	1887
Ernst Bros. Brewing Co.—Second Order	Chicago, Ill	One	35 " ..	35 "	1886
*A. Hupfel's Son	New York	One	35 " ..	35 "	1887
*A. Hupfel's Son—Second Order	New York	One	35 " ..	35 "	1886
George Guenther	Baltimore, Md	One	35 " ..	35 "	1886
Germania Brewing Co	Syracuse, N. Y	One	35 " ..	35 "	1886
W. G. Abbott Brewing Co	Brooklyn, N. Y	One	35 " ..	35 "	1886
N. Molter's Sons	Providence R. I	One	35 " ..	35 "	1887
†J. L. & W. L. Straus	Baltimore, Md	One	35 " ..	35 "	1887
J. L. & W. L. Straus—Second Order	Baltimore, Md	One	65 " ..	65 "	1887
Joseph Stoeckle	Wilmington, Del	One	35 " ..	35 "	1890
Welde & Thomas	Philadelphia, Pa	One	35 " ..	35 "	1888
San Antonio Brewing Co	San Antonio, Tex	One	35 " ..	35 "	1888
Jos. Fallert Brewing Co	Brooklyn, N. Y	One	35 " ..	35 "	1888
Jos. Fallert Brewing Co.—Second Order	Brooklyn, N. Y	One	35 " ..	35 "	1888
Katz Bros	Paterson, N. J	One	35 " ..	35 "	1889
M. Winter & Bros	Pittsburgh, Pa	One	35 " ..	35 "	1888
Burg & Pfaender	Philadelphia, Pa	One	35 " ..	35 "	1889

Name.	Address.	Number of Machines.		Total Refrigeration.	Year of Completion.
Miller Brewing Co	Rochester, N. Y	One	35-ton. . =	35 tons. .	1887
Miller Brewing Co.—Second Order	Rochester, N. Y	One	18 " . .	18 " . .	1888
Leibinger & Oehm	Newtown, N. Y	One	35 " . .	35 " . .	1889
John Schuesler Brewing Co.	Buffalo, N. Y	One	35 " . .	35 " . .	1889
Schaefer & Meyer Brewing Co	Louisville, Ky	One	35 " . .	35 " . .	1889
Hellmann & Kipp	Waterbury, Conn	One	35 " . .	35 " . .	1889
Cincinnati Brewing Co	Hamilton, O	One	35 " . .	35 " . .	1889
Cincinnati Brewing Co. — Second Order	Hamilton, O	One	65 " . .	65 " . .	1890
*Oppmann Brewing Co	Cleveland, O	One	35 " . .	35 " . .	1889
Schmidt & Bro	Cincinnati, O	One	35 " . .	35 " . .	1889
Union Brewing Co	Rochester, N. Y	One	35 " . .	35 " . .	1890
Claussen-Sweeney Brewing Co	Seattle, W. T	One	35 " . .	35 " . .	1890
Kalmbach & Geisel	Springfield, Mass	One	18 " . .	18 " . .	1887
William Smith & Co	Boston, Mass	One	18 " . .	18 " . .	1887
Liebert & Obert	Manayunk, Pa	One	18 " . .	18 " . .	1888
Ph. Schneider Brewing Co	Trinidad, Col	One	18 " . .	18 " . .	1888
Joseph Weibel	New Haven, Conn	One	18 " . .	18 " . .	1888
Joseph Kohnle	Philadelphia, Pa	One	12 " . .	12 " . .	1887
Willibald Kuebler	Easton, Pa	One	12 " . .	12 " . .	1887
*Guayaquil Lager Beer Brewery Ass'n	Guayaquil, Ecuad	One	12 " . .	12 " . .	1887
Loebs Bros	Rochester, N. Y	One	12 " . .	12 " . .	1888
Loebs Bros. (American Brewing Co.)—Second Order	Rochester, N. Y	One	65 " . .	65 " . .	1890
H. Weidemann Brewing Co	New Haven, Conn	One	12 " . .	12 " . .	1889
Theo. R. Helb	York, Pa	One	9 " . .	9 " . .	1885
Eckart Bros	Bridgeport, Conn	One	9 " . .	9 " . .	1885
Eckart Bros.—Second Order	Bridgeport, Conn	One	9 " . .	9 " . .	1886
Herrall & Zimmerman	Portland, Ore	One	9 " . .	9 " . .	1885
G. Mander	Elmira, N. Y	One	9 " . .	9 " . .	1889
Theo. Finkenauer	Philadelphia, Pa	One	9 " . .	9 " . .	1887
Theo. Finkenauer—Second Order	Philadelphia, Pa	One	18 " . .	18 " . .	1889

ABATTOIRS AND PACKING-HOUSES.

*T. C. Eastman	New York	Two	110-ton. . =	220 tons. .	1884
W. H. Silberhorn	Sioux City, Ia	Two	50 " . .	100 " . .	1887
Nelson New River Platte Meat Co.	Zaratte, Argentine Republic	One	65 " . .	65 " . .	1890
Argentine Meat Co., Limited	Colon, Argentine Republic	One	65 " . .	65 " . .	1890
G. Sansinena & Co	Buenos Ayres, Argentine Republic	One	65 " . .	65 " . .	1890
St. Louis Beef Canning Co	E. St. Louis, Ill	One	64 " . .	64 " . .	1882
East Side Hide Association	New York	One	50 " . .	50 " . .	1889
Ryan Brothers	Cincinnati, O	One	35 " . .	35 " . .	1887
Rohe & Bro	New York	One	35 " . .	35 " . .	1884
*Rohe & Bro.—Second Order	New York	One	9 " . .	9 " . .	1886
Rohe & Bro.—Third Order	New York	One	35 " . .	35 " . .	1888
*Richard Webber	New York	One	35 " . .	35 " . .	1888
A. Sander & Co	Cincinnati, O	One	18 " . .	18 " . .	1886
Hart & Brother	Wilmington, Del	One	18 " . .	18 " . .	1886
Burkhardt Packing Co	Denver, Col	One	18 " . .	18 " . .	1888
Arnold Bros	Chicago, Ill	One	18 " . .	18 " . .	1889
Arnold Bros.—Second Order	Chicago, Ill	One	18 " . .	18 " . .	1889
Griffin & McElroy	Bridgeport, Conn.	One	18 " . .	18 " . .	1889
Gebhardt W. Zeiger	Chicago, Ill	One	12 " . .	12 " . .	1889
Wm. Ottmann & Co	New York	One	18 " . .	18 " . .	1890
R. D. Waddell	Glasgow, Scotland	One	4 " . .	4 " . .	1890

COLD STORAGE.

Name.	Address.	Number of Machines	Total Refrigerat'n.	Year of Compl'n.
†Quaker City Cold Storage and Warehouse Co.	Philadelphia, Pa.	Two 65-ton	=130 tons	1890
Purfleet Wharf	London, Eng.	Two 40 "	80 "	1888
Leadenhall Market	London, Eng.	One 35 "	35 "	1888
*Washington Market Co.	Washington, D. C.	One 35 "	35 "	1888
Spiers & Pond	London, Eng.	One 4 "	4 "	1888
Fred Hollender & Co.	New York	One 4 "	4 "	1883

HOTELS AND RESTAURANTS.

*Murray Hill Hotel	New York	One 9-ton	=9 tons	1886
*Plaza Hotel	New York	One 9 "	9 "	1890
*Portland Hotel Co.	Portland, Ore.	One 4 "	4 "	1890
Hotel Luehrmann	Memphis, Tenn.	One 2 "	2 "	1889
†Geo. D. Smith (The Metropolis)	New York	One 2 "	2 "	1888

CHEMICAL WORKS.

St. Louis Ammonia & Chem. Co.	Cincinnati, O.	One 18-ton	=18 tons	1886
Baugh & Sons Co.	Philadelphia, Pa.	One 12 "	12 "	1887
M. A. Seed Dry Plate Co.	St. Louis, Mo.	One 9 "	9 "	1887
M. A. Seed Dry Plate Co.—Second Order	St. Louis, Mo.	One 9 "	9 "	1890

CONFECTIONERS AND CHOCOLATE MFRS.

Cy Gousset	New York	One 4-ton	=4 tons	1888
Croft & Allen	Philadelphia, Pa.	One 4 "	4 "	1889
Runkel Bros.	New York	One 4 "	4 "	1889

STEAMSHIPS.

*Oceanic Steamship Co.	Str. *Australia*	One 2-ton	=2 tons	1889

WINERIES.

American Champagne Co.	San Francisco, Cal.	One 9-ton	=9 tons	1889

ARTIFICIAL ICE PLANTS.

(WITH MACHINES.)

Name.	Address.	Ice Making Capacity Machines.	Refrigerating Capacity.	
Bohlen-Huse Machine and Lake Ice Co.	Memphis, Tenn.	One 30-ton	=50-tons	1887
Bohlen-Huse Machine and Lake Ice Co.—Second Order	Memphis, Tenn.	One 30 "	50 "	1889
Buffalo Brewing Co.—Second Order	Sacramento, Cal.	One 30 "	50 "	1890
Crystal Ice Mfg. Co.	San Antonio, Tex.	One 20 "	35 "	1890
Count Albini	Rome, Italy	One 10 "	18 "	1887
Anheuser-Busch Brewing Ass'n —Fifth Order	Sherman, Tex.	One 10 "	18 "	1889
Anheuser-Busch Brewing Ass'n —Sixth Order	St. Louis, Mo.	One 130 "	220 "	1889
E. M. Barretto	Manila, Philippine Islands	One 5 "	9 "	1885
E. M. Barretto—Second Order	Manila, Philippine Islands	One 5 "	9 "	1886
West Indian Ice and Refrigerating Co., Limited	Port of Spain, Trinidad Isl'd, B. A. I.	One 5 "	9 "	1885
J. L. Millsbaugh	Fort Concho, Tex.	One 2 "	4 "	1884
Edgar Fennell	Newport, Eng.	One 1 "	2 "	1890

254 Machines, equivalent in Tons of Ice melted each day, 11,377.

* Brine plants.

† Partly Brine and partly direct-expansion plants. All others are direct-expansion plants.

SUPPLEMENT No. 1.

MACHINES SOLD FROM JANUARY 1, TO APRIL 1, 1890.

BREWERIES.

Name.	Address.	Number of Machines	Total Refrigerat'n.	Year of. Compl'n.
The Christian Moerlein Brewing Co	Cincinnati, O.	One 100-ton..	=100-tons	1890
St. Louis Brewing Ass'n, Cherokee Brewery Branch	St. Louis, Mo.	One 65 " ..	65 "	1890
Fred. Hower Brewing Co	Brooklyn, N. Y.	Two 35 " ..	70 "	1890
Christian Moerlein & Wm. Gerst.	Nashville, Tenn.	One 65 " ..	65 "	1890
Hinchliffe Brewing Co	Paterson, N. J.	One 50 " ..	50 "	1890
*George Brehm	Baltimore, Md.	One 50 " ..	50 "	1890
Herman Straub & Co	Pittsburgh, Pa,	One 50 " ..	50 "	1890
The Grasser & Brand Brewing Co.—Second Order	Toledo, O	One 35 " ..	35 "	1890
M. Winter Bros.—Second Order.	Pittsburgh, Pa.	One 65 " ..	65 "	1890
Oppman Brewing Co.—Second Order	Cleveland, O.	One 65 " ..	65 "	1890
Edward Habich, Norfolk Brewery	Boston, Mass.	One 35 " .	35 "	1890
George V. Muth	Cleveland, O.	One 35 " ..	35 "	1890
Indianapolis Brewing Co., P. Lieber Branch	Indianapolis, Ind.	One 35 " ..	35 "	1890
George Hauck	Rondout, N. Y.	One 18 " ..	18 "	1890
Springfield Brewing Co.	Springfield, Mass.	One 18 " ..	18 "	1890

ABATTOIRS AND PACKING HOUSES.

T. M. Sinclair & Co.	Cedar Rapids, Ia.	Two 100-ton..	=200 tons	1890
Joseph Stern	New York	One 65 " ..	65 "	1890
Jeremiah Murphy	St. Louis, Mo.	One 35 " ..	35 "	1890
Murray & Bro.	Rockaway Beach, N. Y.	One 2 " ..	2 "	1890

MARKETS AND COLD STORAGE.

Otto Huber Brewery — Third Order	Far Rockaway, N. Y.	One 2-ton..	= 2 tons	1890

HOTELS AND RESTAURANTS.

*Iroquois Hotel	Buffalo, N. Y.	One 9-ton..	= 9 tons	1890

CONFECTIONERS AND CHOCOLATE MFRS.

Fobes, Hayward & Co	Boston, Mass.	One 9-ton..	= 9 tons	1890

ARTIFICIAL ICE PLANTS.

(WITH MACHINES.)

Name.	Address.	Machines.	Ice Making Capacity	Refrigerating Capacity.	Year of Compl'n.
A. Griesedieck Artificial Ice Co.	St. Louis, Mo.	One	60-ton..	=150 tons	1890
Krueger's Hygiene Ice Co.—Third Order	Newark, N. J.	Two	60 "	200 "	1890
New York Hygeia Ice Co. (Limited)	New York	Two	60 "	200 "	1890
New York Ice Co.	New York	One	60 "	100 "	1890
Otto Huber—Fourth Order	Brooklyn, N. Y.	One	30 "	50 "	1890
Montgomery Brewing Co.	Montgomery, Ala.	One	30 "	50 "	1890

ARTIFICIAL ICE PLANTS.

(OPERATED IN CONNECTION WITH MACHINES ALREADY ON PREMISES.)

Name.	Address.	Ice Making Capacity.	
William J. Lemp—Third Order	St. Louis, Mo.	120 tons	1890
St. Louis Brewing Association, Schneider Brewery Branch—Second Order	St. Louis, Mo.	30 "	1890
St. Louis Brewing Association, Klausmann Brewery Branch—Third Order	St. Louis, Mo.	20 "	1390
P. Ballantine & Sons—Fourth Order	Newark, N. J.	18 "	1890
Wm. Ottman & Co.	New York	2 "	1890
Western Brewery Co.	Belleville, Ill.	20 "	1890

GRAND TOTAL:

286 *Machines, equivalent in Tons of Ice melted each day,* 13,205.

SUPPLEMENT No. 2.

MACHINES SOLD FROM APRIL 1, 1890, TO APRIL 1, 1892.

BREWERIES.

Name.	Address.	Number of Machines.		Total Refrigeration.	Year of Compl'n.
Union Brewing Co	Union Hill, N. J.	One	18-ton. . =	18 tons	1890
Wm. Ruehl Brewing Co	Chicago, Ill	One	65 "	65 "	1890
(For Second Order from Wm. Ruehl Brewing Co, see *Artificial Ice Plants*).					
Fecker Brewing Co	Chicago, Ill	One	35 "	35 "	1891
Pabst Brewing Co. — Second Order	Milwaukee, Wis	One	300 "	300 "	1891
Louis Bergdoll Brewing Co.—Second Order	Philadelphia, Pa	One	100 "	100 "	1891
Consumers' Brewing Co	New York	Two	100 "	200 "	1891
Texas Brewing Co	Fort Worth, Tex	One	50 "	50 "	1891
(For Second and Third Order from Texas Brewing Co., see *Artificial Ice Plants*).					
Wm. J. Lemp—Fourth Order	St. Louis, Mo	One	220 "	220 "	1891
Wm. J. Lemp—Fifth Order	St. Louis, Mo	One	220 "	220 "	1891
Milwaukee Brewing Co	Denver, Col	One	65 "	65 "	1891
Continental Brewing Co.—Third Order	Philadelphia, Pa	One	100 "	100 "	1891
Ernst Ochs	Brooklyn, N. Y	One	50 "	50 "	1891
St. Louis Brewing Association — Fourth Order (Winkelmeyer Branch)	St. Louis, Mo	One	50 "	50 "	1892
St. Louis Brewing Association —Fifth Order (Klausmann Branch)	St. Louis, Mo	One	50 "	50 "	1892
St. Louis Brewing Association --Sixth Order (Bremen Br'ch.	St. Louis, Mo	One	50 "	50 "	1891
Bergner & Engel Brewing Co—Fourth Order	Philadelphia, Pa	One	100 "	100 "	1891
F. W. Cook Brewing Co	Evansville, Ind	One	65 "	65 "	1891
Estate of Geo. Bechtel (dec'd)	Stapleton, S. I	One	100 "	100 "	1891
Falk, Jung & Bochert Brewing Co.—Second Order	Milwaukee, Wis	One	100 "	100 "	1891
Theo. R. Helb—Second Order	York, Pa	One	18 "	18 "	1891
Wm. Smith & Co.—Second Order	Boston, Mass	One	35 "	35 "	1891
H. Koehler & Co	New York	One	50 "	50 "	1891
Charles Frese	Brooklyn, N. Y	One	35 "	35 "	1891
Geo. Malcom Brewing Co	Brooklyn, N. Y	One	50 "	50 "	1891
Beadleston & Woerz — Second Order	New York	One	100 "	100 "	1891
McCormick Brewing Co	Boston, Mass	One	35 "	35 "	1891
American Brewing Co	Boston, Mass	One	50 "	50 "	1891
Jos. Schlitz Brewing Co.—Third Order	Milwaukee, Wis	One	100 "	100 "	1891

Name.	Address.	Number of Machines.	Total Refrigerat'n.	Year of Compl'n.
Jos. Schlitz Brewing Co.—Fourth Order	Memphis, Tenn.	One 12-ton	=12 tons	1891
Goebel Brewing Co	Detroit, Mich	One 65 "	65 "	1891
*John F. Betz & Son	Philadelphia, Pa	One 100 "	100 "	1892
Iron City Brewing Co	Pittsburgh, Pa	One 65 "	65 "	1891
John Roessle—Second Order	Boston, Mass	One 65 "	65 "	1891
Crescent Brewing Co	Aurora, Ind	One 50 "	50 "	1891
Geo. Gunther—Second Order	Baltimore, Md	One 35 "	35 "	1891
Anheuser-Busch Brewing Association—Seventh Order	St. Louis, Mo	One 500 "	500 "	1892
Anheuser-Busch Brewing Association—Eighth Order	Brooklyn, N. Y.	One 4 "	4 "	1891
(For Ninth Order from Anheuser-Busch Brewing Ass'n, see *Artificial Ice Plants*).				
Genesee Brewing Co	Rochester, N. Y.	One 65 "	65 "	1891
Geo. Ehret—Third Order	New York	One 110 "	110 "	1891
Welde & Thomas—Second Order	Philadelphia, Pa.	One 65 "	65 "	1891
†A. Kremer Brewing Co	Guttenberg, N. J.	One 35 "	35 "	1891
B. Stroh Brewing Co.—Second Order	Detroit, Mich	One 75 "	75 "	1891
Koppitz-Melchers Brewing Co.	Detroit, Mich	One 35 "	35 "	1891
Indianapolis Brewing Co. (P. Lieber Branch)	Indianapolis, Ind.	One 35 "	35 "	1890
Indianapolis Brewing Co.—(P. Lieber Branch)—Second Order	Indianapolis, Ind.	One 35 "	35 "	1891
Emil Kersten	Richmond, Va	One 18 "	18 "	1891
San Antonio Brewing Association—Second Order	San Antonio, Tex.	One 65 "	65 "	1891
Cincinnati Brewing Co.—Third Order	Hamilton, O.	One 100 "	100 "	1891
C. Feigenspan—Third Order	Newark, N. J.	One 100 "	100 "	1891
Howard & Childs	New York	One 50 "	50 "	1891
American Brewing Co.—Second Order	Chicago, Ill	One 65 "	65 "	1892
Christian Schmidt—Second Order	Philadelphia, Pa.	One 100 "	100 "	1892
Fred Miller Brewing Co.—Third Order	Milwaukee, Wis.	One 150 "	150 "	1892
Bartholomay Brewery Co.—Third Order	Rochester, N.Y.	One 220 "	220 "	1892
Citizens' Brewing Co	Chicago, Ill	One 65 "	65 "	1892
New Jersey & San Domingo Brewing Co	San Domingo, Hayti	Two 18 "	36 "	1892
Christian Moerlein Brewing Co.—Second Order	Cincinnati, O.	One 300 "	300 "	1892
National Brewery Co	St. Louis, Mo	One 100 "	100 "	1892
Minneapolis Brewing & Malting Co	Minneapolis, Minn.	Two 100 "	200 "	1892
Springfield Brewing Co.—Second Order	Springfield, Mass.	One 35 "	35 "	1892
Charles A. King—Second Order	Boston, Mass	One 65 "	65 "	1892
Chas. Gowen & Sons	Victoria, B. C.	One 9 "	9 "	1892
Jacob Ruppert—Third Order	New York	One 220 "	220 "	1892
Star Brewing Co	Chicago, Ill	One 100 "	100 "	1892
Leonhard Eppig—Second Order	Brooklyn, N.Y.	One 100 "	100 "	1892
Doerschuck & Heinbockel	Brooklyn, N.Y.	One 50 "	50 "	1892

Name.	Address.	Number of Machines.		Total Refrigerat'n.	Year of Compl'n.
C. A. Koenig	Auburn, N. Y	One	18-ton..	=18 tons	1892
Eldredge Brewing Co	Portsmouth, N.H	One	35 "	35 "	1892
Columbia Brewing Co	St. Louis, Mo	One	100 "	100 "	1892
American Brewing Co	Providence, R. I.	One	65 "	65 "	1892
*Fred Kayser	Beziers, France	One	18 "	18 "	1892
Palmetto Brewing Co	Charleston, S. C	One	35 "	35 "	1892
Burkhardt Brewing Co	Boston, Mass	One	50 "	50 "	1892
Burg & Pfaender—Second Order	Philadelphia, Pa	One	65 "	65 "	1892

ABATTOIRS AND PACKING HOUSES.

J. Rawson & Son	Cincinnati, Ohio	One	50-ton..	=50 tons	1891
J. P. Squire & Co	East Cambridge, Mass	Two	150 "	300 "	1892
Wm. D. Grant	St. Louis, Mo	One	35 "	35 "	1892
*Henry Lux & Sons	Utica, N. Y	One	9 "	9 "	1891

MARKETS AND COLD STORAGE.

†Quincy Market Cold Storage Co	Boston, Mass	One	100-ton..	=100 tons	1891
*Philadelphia Market Co	Philadelphia, Pa	Two	50 "	100 "	1891
†Sheriff Street Market & Storage Co	Cleveland, Ohio	Two	100 "	200 "	1892
Produce Cold Storage Exch'ge	Chicago, Ills	Two	65 "	130 "	1892
Donovan & Co	S. Norwalk, Conn	One	2 "	2 "	1891

CONFECTIONERS AND CHOCOLATE MFRS.

Gustav Helmstetter	New York City	One	4-ton	=4 tons	1891

CHEMICAL WORKS.

Eagle Oil Co	Bayonne, N. J	One	65 "	65 "	1891
The Eastman Co	Rochester, N. Y	One	50 "	50 "	1891

STEAMSHIPS.

*Wilson Line—*Lydian Monarch*	London	One	6 "	6 "	1890
*Wilson Line—*Persian Monarch*	London	One	6 "	6 "	1890
North German Lloyd S. S. Co. —*Spree*	Bremen	One	1 "	1 "	1891

MINERAL WATER MFRS.

Carl H. Schultz	New York	One	18-ton..	=18 tons	1891

HOTELS.

*Waldorf Hotel	New York	Two	9 "	18 "	1892
*Plaza Hotel—Second Order	New York	One	8 "	8 "	1891

SCIENTIFIC INSTITUTIONS.

American Brewing Academy	Chicago, Ills	One	2 "	2 "	1892

ARTIFICIAL ICE PLANTS.

(WITH MACHINES)

Name.	Address.	Ice Making Capacity Machines.	Refrigerat'g Capacity.	Year of Compl'n.
Frank Fehr	Louisville, Ky.	Two 60-ton	=200 tons.	1890
Arthur S. Plews	Barbadoes, W. I.	One 20 "	35 "	1891
Arthur S. Plews—Second Order	Trinidad, W. I.	One 10 "	18 "	1892
Arthur S. Plews—Third Order.	Kingston, Jamaica.	One 10 "	18 "	
Arthur S. Plews—Fourth Order	Georgetown, Br. Guiana	Two 10 "	36 "	1892
N. Y. Hygeia Ice Co. (Limited)—Second Order	New York City	One 90 "	150 "	1891
Scruggs & Ewing	Union City, Tenn.	One 10 "	18 "	1891
Planters' Oil, Guano & Ice Co.	Macon, Ga.	One 20 "	35 "	1891
J. H. Cavanaugh	Savannah, Ga.	One 30 "	50 "	1891
Glen Willow Ice Mfg. Co.	Philadelphia, Pa.	One 60 "	100 "	1892
Texas Brewing Co. — Second Order	Fort Worth, Tex.	One 30 "	50 "	1891
Texas Brewing Co.—Third Order	Fort Worth, Tex.	One 60 "	100 "	1892
Louisiana Artificial Ice & Cold Storage Co.	Baton Rouge, La.	One 30 "	50 "	1892
Shreveport Ice & Refr'tg Co.	Shreveport, La.	One 30 "	50 "	1892
Anheuser-Busch Brewing Association—Ninth Order	Houston, Tex.	One 60 "	100 "	1892
Consumers' Ice Co	New Orleans, La.	One 60 "	100 "	1892
Bohlen-Huse Machine & Lake Ice Co.—Third Order	Memphis, Tenn.	One 60 "	100 "	1891

ARTIFICIAL ICE PLANTS.

(OPERATED IN CONNECTION WITH MACHINES ALREADY ON PREMISES.)

Name.	Address.	Ice Making Capacity.	Year of Completion.
Meyer's Hygiene Ice Co.	New York	50 tons	1890
Quaker City Cold Storage & Warehouse Co.—Second Order	Philadelphia, Pa	28 "	1890
Wm. Ruehl Brewing Co.—Second Order	Chicago, Ill.	25 "	1890
Lone Star Brewing Co.	San Antonio, Tex.	10 "	1891
National Brewing Co.—Third Order	Baltimore, Md.	7 "	1890
McElroy Bros.—Second Order	Bridgeport, Conn	5 "	1890
A. Hupfel's Son—Third Order	New York	2 "	1890
Sheriff Street Market & Storage Co	Cleveland, Ohio	30 "	1892
M. Winter & Bros.—Third Order	Pittsburgh, Pa	10 "	

GRAND TOTAL:

406 *Machines, equivalent in Tons of Ice melted each day,* 21,795.

* Brine Plants.
† Partly brine and partly direct-expansion plants. All others are direct-expansion plants.

PLATE 1.—Office and Works of the De La Vergne Refrigerating Machine Co.